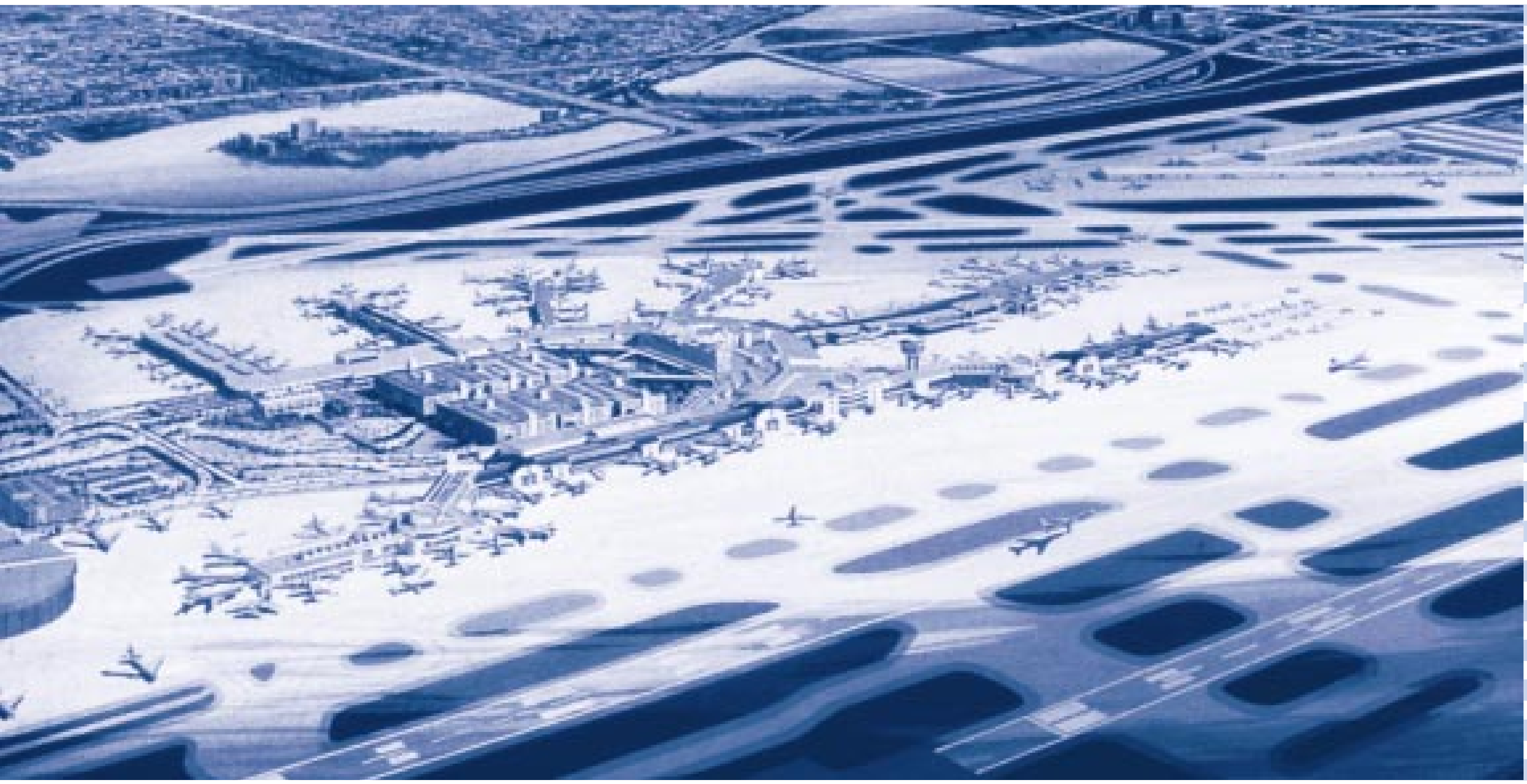
MIAMI INTERNATIONAL AIRPORT



CAPACITY ENHANCEMENT PLAN UPDATE

Miami International Airport

Capacity Enhancement Plan Update

December 1997

Prepared jointly by the U.S. Department of Transportation, Federal Aviation Administration, the Dade County Aviation Department, and the airlines and general aviation serving Miami, Florida.

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Executive Summary

Airport Capacity Design Teams are formed to identify and recommend capacity enhancements at airports with significant flight delays. The teams are composed of FAA representatives from the Office of System Capacity (ASC), the Technical Center, and the appropriate FAA Region; airport owners/operators; airlines; and other aviation industry representatives. The goal of the Design Team is to identify and evaluate proposals that will increase airport capacity, improve airport efficiency and reduce aircraft delays while maintaining or improving aviation safety.

Steady traffic growth at Miami International Airport (MIA) has placed it at number six on the list of 100 busiest airports in the country ranked by passenger enplanements. Activity at the airport increased from 9,153,000 passenger enplanements in 1983 to 14,777,636 in 1995, an increase of over 61 percent. In 1983, the airport handled 341,000 aircraft operations (takeoffs and landings), and, in 1995, 576,609 aircraft operations, an increase of more than 69 percent. This growth, according to FAA projections, will keep Miami on the list of airports experiencing over 20,000 hours of annual delay through the year 2004, if no capacity improvements are made.

An Airport Capacity Design Team for Miami International Airport was formed in 1986. That Design Team identified and assessed various actions that, if implemented, would increase MIA's capacity, improve operational efficiency, and reduce aircraft delays. The Team published a report in June 1989 containing recommendations for increasing capacity and reducing delays. Subsequent changes in the various computer simulation model inputs, growth in traffic at MIA, and the need to reassess and further analyze capacity enhancement alternatives resulted in the need to update the report. Therefore, in September 1995, the FAA formed a second Airport Capacity Design Team for MIA to reassess some of the previously recommended improvements, and assess additional improvements to increase MIA's capacity, improve operational efficiency, and reduce aircraft delays. A major benefit of this effort will be its contribution to the Dade County Aviation Department's ongoing studies for MIA expansion. The purpose of the process was to determine the technical merits of each alternative action and its potential to increase capacity and reduce delays. Additional studies will be needed to assess environmental, socioeconomic, or political issues associated with these actions.

Selected improvements identified by the Design Team were tested using computer models developed by the FAA to quantify the benefits provided. Different levels of activity were chosen to represent growth in aircraft operations in order to compare the merits of each action. These annual activity levels are referred to throughout this report as:

- Baseline — 580,000 operations.
- Future 1 — 680,000 operations.
- Future 2 — 780,000 operations.

Figure 1 depicts a layout of the airport showing the proposed airfield improvements. Figure 2 lists all of the improvements analyzed by the Design Team and shows their delay savings benefits. Figure 3 presents the estimated cost, recommended action and suggested time frame for each capacity enhancement alternative considered by the Design Team. The Design Team's analysis shows that delay costs and annual delays will continue to grow at a substantial rate as demand increases if no improvements are made in airfield capacity. The greatest savings in average delays and delay costs would be provided by: a new non-precision air carrier runway (8/26); establishing a 3rd departure heading for jet takeoffs (day only operations); and, the use of intersection departures for cargo aircraft on Runway 27L. The Design Team recommends implementing these, and other improvements, at the appropriate time as indicated in Figure 3.

Figure 1.　Miami International Airport

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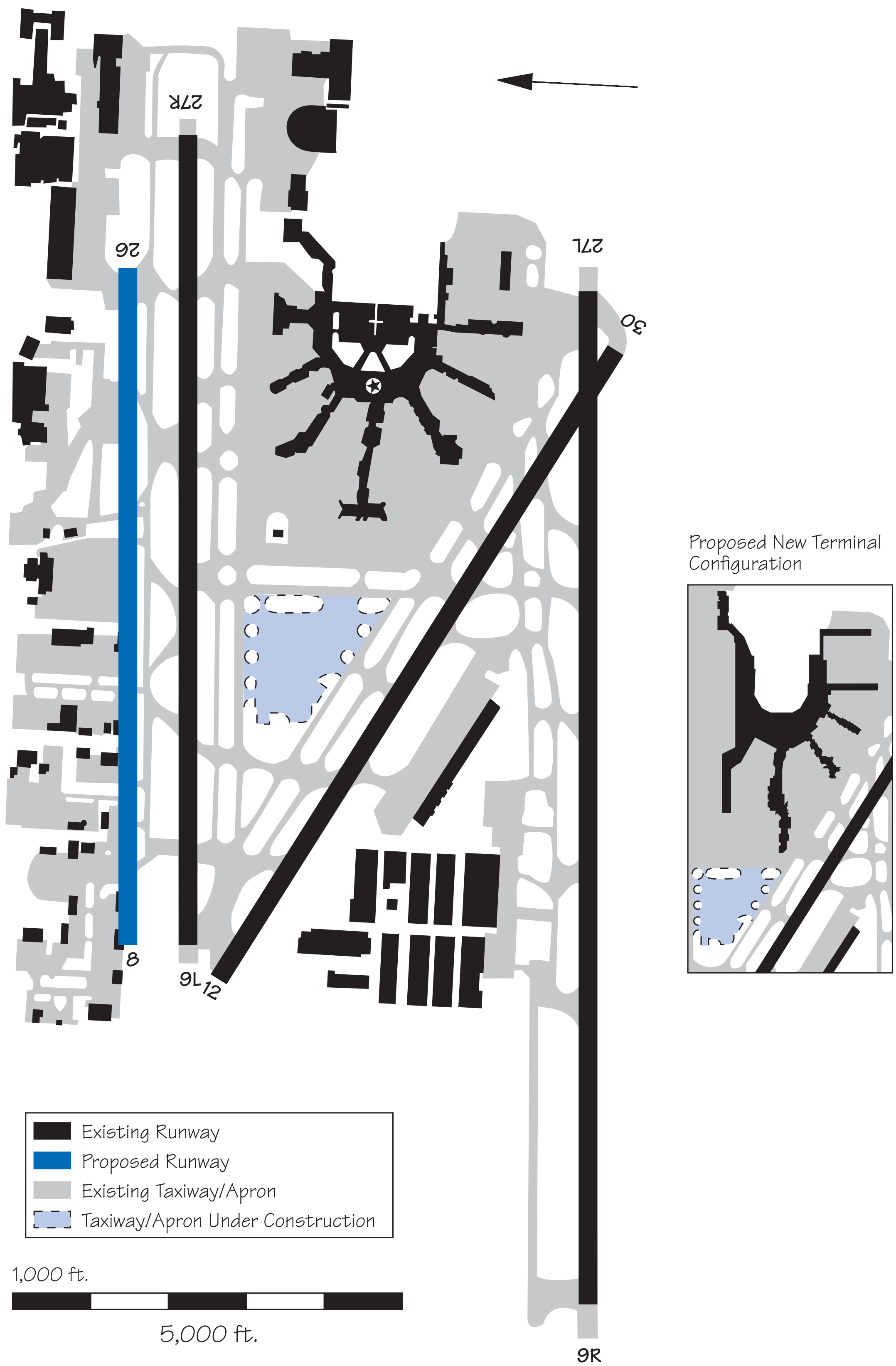


Figure 2. Capacity Enhancement Alternatives and Annual Delay Savings

Airfield Improvements	Estimated Annual Delay Savings (in hours and millions of 1996 dollars) Baseline (580,000)	Future 1 (680,000)	Future 2 (780,000)
1. New Non-Precision Runway 8/26 800' North of Runway 9L/27R:			
a. 8,600' Air Carrier Runway	17,420/$36.95	94,920/$201.32	397,840/$843.83
b. 6,000' Commuter Runway	13,720/$29.11	87,110/$184.77	361,310/$766.35
2. Install Touchdown Zone Lights on Runways 9R, 12, 27L, 27R, and 30		See Narration	
Facilities and Equipment Improvements			
3. CAT II/III ILS on Runway 9R		See Narration	
4. Install Glide Slope (End Fire), MALSR, and Middle Marker on Runway 30		See Narration	
5. Install MALSR on Runway 12		See Narration	
6. Integrated Terminal Weather System (ITWS)		See Narration	
7. Surface Movement Advisor (SMA)		See Narration	
8. *Vortex Advisory System (VAS)/AVOSS			
a. Simultaneous Departures from Three Parallel Runways (VFR)	400/$0.85	270/$0.57	2,570/$5.44
b. Simultaneous Departures and Arrivals to Three Parallel Runways (VFR)	2,110/$4.48	3,880/$8.23	15,050/$31.90
Operational Improvements			
9. *Dependent Non-Precision Approach to New Runway 8/26	120/$0.26	640/$1.36	840/$1.76
10. Side-Step Non-Precision Approach to New Runway 8/26		See Narration	
11. Intersection Departures for Commuter/Small Aircraft		See Narration	
12. *Intersection Departures for Cargo Aircraft on Runway 27L	(30/$0.07)	4,410/$9.36	10,620/$22.52
13. *Optimize Runway Crossing/Taxi Paths and flows for New Runway, Runway 9L/27R and Terminal Area	580/$1.24	(910/$1.93)	1,010/$2.12
14. Reduced IFR Arrival In-Trail Spacing to 2 Nautical Miles	470/$0.99	610/$1.29	400/$0.85
15. Establish 3rd Departure Heading for Jet Takeoffs in Westflow Conditions			
a. Day and Night Operations	1,450/$3.08	17,570/$37.26	23,630/$50.13
b. Day Only Operations (7AM - 10PM)	1,540/$3.27	17,020/$36.09	22,900/$48.57
16. Operational Impact of New Large Aircraft		See Narration	
17. Standard Taxi Routes		See Narration	
18. *Use of Taxiway U for Runway 26 Commuter Departures in Westflow Conditions	280/$0.59	4,710/$10.00	(2,660/$5.66)
User or Policy Improvements			
19. Uniformly Distribute Scheduled Commercial Operations	6,870/$14.57	5,690/$12.06	19,850/$42.09
20. *Effect of Noise Abatement Restrictions	(1,520/$3.21)	(2,990/$6.34)	(7,130/$15.14)
21. Enhancement of the Reliever and GA Airport System		See Narration	

Note: Delay savings benefits of the improvements are not necessarily additive. They are based on a comparison of each alternative with the existing airfield (Do-Nothing) case unless otherwise noted.

* Delay savings/(costs) of these improvements are based on a comparison with Improvement 1a (new air carrier runway).

Figure 3. Capacity Enhancement Alternatives Studied and Recommended Actions

Airfield Improvements	Estimated Cost (Millions of 1996 $)	Action	Time Frame
1. New Non-Precision Runway 8/26 800' North of Runway 9L/27R:			
a. 8,600' Air Carrier Runway	$180.0	Recommended	Baseline
b. 6,000' Commuter Runway	$125.0	Not Recommended	
2. Install Touchdown Zone Lights on Runways 9R, 12, 27L, 27R, and 30	$2.2	Recommended	Baseline
Facilities and Equipment Improvements			
3. CAT II/III ILS on Runway 9R	$3.0	Recommended	Baseline
4. Install Glide Slope (End Fire), MALSR, and Middle Marker on Runway 30	$1.5	Recommended	Baseline
5. Install MALSR on Runway 12	$2.0	Recommended	Baseline
6. Integrated Terminal Weather System (ITWS)	N/A	Recommended	Baseline
7. Surface Movement Advisor (SMA)	N/A	Recommended	Baseline
8. Vortex Advisory System (VAS)/AVOSS			
a. Simultaneous Departures from Three Parallel Runways (VFR)	N/A	Recommended	Baseline
b. Simultaneous Departures and Arrivals to Three Parallel Runways (VFR)	N/A	Recommended	Baseline
Operational Improvements			
9. Dependent Approaches to New Runway 8/26	N/A	Recommended	Baseline
10. Side-Step Approach to New Runway 8/26	N/A	Recommended	Baseline
11. Intersection Departures for Commuter/Small Aircraft	N/A	Recommended †	Baseline
12. Intersection Departures for Cargo Aircraft on Runway 27L	N/A	Recommended	Baseline
13. Optimize Runway Crossing/Taxi Paths and flows for New Runway, Runway 9L/27R and Terminal Area	N/A	Recommended	Baseline
14. Reduced IFR Arrival In-Trail Spacing to 2 Nautical Miles	N/A	Recommended	Baseline
15. Establish 3rd Departure Heading for Jet Takeoffs in Westflow Conditions			
a. Day and Night Operations	N/A	Not Recommended	
b. Day Only Operations (7AM - 10PM)	N/A	Recommended	Baseline
16. Operational Impact of New Large Aircraft	N/A	Further Study	
17. Standard Taxi Routes	N/A	Further Study	
18. Use of Taxiway U for Runway 26 Commuter Departures in Westflow Conditions	N/A	Recommended	Baseline
User or Policy Improvements			
19. Uniformly Distribute Scheduled Commercial Operations	N/A	Not Recommended	
20. Effect of Noise Abatement Restrictions	N/A	Further Study	
21. Enhancement of the Reliever and GA Airport System	N/A	Recommended	Baseline

† Included in Improvement 1a

Section 1

Introduction

Background

Recognizing the problems posed by congestion and delay within the National Airspace System, the Federal Aviation Administration (FAA) asked the aviation community to study the problem of airport congestion through the Industry Task Force on Airport Capacity Improvement and Delay Reduction chaired by the Airport Operators Council International.

By 1984, aircraft delays recorded throughout the system highlighted the need for more centralized management and coordination of activities to relieve airport congestion. In response, the FAA established the Airport Capacity Program Office, now called the Office of System Capacity (ASC). The goal of this office and its capacity enhancement program is to identify and evaluate initiatives that have the potential to increase capacity, so that current and projected levels of demand can be accommodated within the system with a minimum of delay and without compromising safety or the environment.

In 1985, the FAA initiated a renewed program of Airport Capacity Design Teams at various major air carrier airports throughout the U.S. Each Design Team identifies and evaluates alternative means to enhance existing airport and airspace capacity to handle future demand and works to develop a coordinated action plan for reducing airport delay. Forty Airport Capacity Design Teams have either completed their studies or have work in progress.

The need for this program continues. In 1995, 25 airports exceeded 20,000 hours of airline flight delays. If no improvements in capacity are made, the number of airports that could exceed 20,000 hours of delay is projected to grow from 25 to 29 by 2004.

The challenge for the air transportation industry in the nineties is to enhance existing airport and airspace capacity and to develop new facilities to handle future demand. As environmental, financial, and other constraints continue to restrict the development of new airport facilities in the U.S., an increased emphasis has been placed on the redevelopment and expansion of existing airport facilities.

Miami International Airport

Miami International Airport (MIA) is the 6th busiest airport in the country when ranked by passenger enplanements. In the past decade, MIA has experienced steady, sustained growth. Enplanements at MIA rose from 9,153,000 in 1983 to 14,777,636 in 1995, an increase of over 61 percent. MIA's total aircraft operations (takeoffs and landings) reached 576,609 in 1995, an increase of more than 69 percent over the 341,000 aircraft operations the airport handled in 1983.

Miami International Airport is owned and operated by Dade County, Florida. The airport is located on approximately 3,200 acres of land about 6 miles west of downtown Miami.

The airfield currently has three runways:

- Runway 9R/27L is 13,000 feet long and 150 feet wide.
- Runway 9L/27R is 10,502 feet long and 200 feet wide.
- Runway 12/30 is 9,355 feet long and 150 feet wide.

Miami Airport Capacity Design Team

An Airport Capacity Design Team for MIA was formed in 1986. The Design Team identified and assessed various actions that, if implemented, would increase MIA's capacity, improve operational efficiency, and reduce aircraft delays. The Team published their recommendations in June 1989. Many of these recommendations have been implemented.

Since the publication of the June 1989 report, changes have occurred to airport operations that affect some of the various computer simulation model inputs. Also, traffic growth at MIA and the need to reassess and further analyze capacity enhancement alternatives resulted in the need to update the report.

Therefore, a second Airport Capacity Design Team for MIA was formed in September 1995. The MIA Design Team identified and assessed various actions that, if implemented, would increase capacity, improve operational efficiency, and reduce aircraft delays. The purpose of the process was to determine the technical merits of each alternative action and its impact on capacity. Additional studies will be needed to assess environmental, socioeconomic, or political issues associated with these actions.

This report has established benchmarks for development based on traffic levels and not upon any definitive time schedule, since actual traffic growth can vary year to year from projections. As a result, the report should retain its validity until the highest traffic level is attained regardless of the actual dates corresponding to these traffic levels.

A Baseline benchmark of 580,000 aircraft operations (takeoffs and landings) was established based on the actual 1995 traffic level. Two future traffic levels, Future 1 and Future 2, were established at 680,000, and 780,000 annual aircraft operations respectively, based on Design Team consensus of potential traffic growth at Miami International. If no improvements are made at MIA, annual delay levels and delay costs are expected to increase from an estimated 41,677 hours (4.31 minutes per operation)and $88.40 million at the Baseline activity level to 151,598 hours (13.38 minutes per operation) and $321.54 million by the Future 1 and 542,174 hours (41.71 minutes per operation) and $1,149.95 million by the Future 2 demand levels.

The Design Team recognizes that the Future 2 level of delay estimated by the unconstrained computer simulation would not actually occur. This level of delay would be unacceptable to the airlines and their passengers. At some level of delay prior to this, the capacity of MIA would be reached and further growth in the traffic would be constrained. However, it does point out that if no improvements are made at MIA, at some point beyond Future 1, delays and delay costs will become unacceptable.

The Design Team studied various proposals with the potential for increasing capacity and reducing delays at MIA. The improvements evaluated by the Design Team are delineated in Figure 2 and described in some detail in Section 2, Capacity Enhancement Alternatives.

Objectives

The major goal of the Design Team was to identify and evaluate alternatives that would increase airport capacity, improve airport efficiency, and reduce aircraft delays. In achieving this objective, the Design Team:

- Assessed the current airport capacity.
- Examined the causes of delay associated with the airfield, the immediate airspace, and the apron and gate-area operations.
- Evaluated capacity and delay benefits of alternative air traffic control (ATC) procedures, navigational improvements, airfield development, and operational improvements.

Scope

The Design Team limited its analyses to aircraft activity inside the final approach fix and on the airfield. They considered the operational benefits of the proposed airfield improvements, but did not address environmental, socioeconomic, or political issues regarding airport development. These issues need to be addressed in future airport planning studies, and the data generated by the Design Team can be used in such studies.

Methodology

The Design Team, which included representatives from the FAA, the Dade County Aviation Department (DCAD), and various aviation industry groups (see Appendix A), met periodically for review and coordination. The Design Team members considered capacity improvement alternatives proposed by the FAA's Office of System Capacity and Requirements, Technical Center, and Regional Airport Capacity Program Manager, DCAD, and by other members of the Team. Alternatives that were considered practicable were developed into experiments that could be tested by simulation modeling. The Design Team validated the data used as input for the simulation modeling and analysis and reviewed and interpreted the simulation results. The data, assumptions, alternatives, and experiments were continually reevaluated, and modified where necessary, as the study progressed. A primary goal of the study was to develop a set of recommendations for capacity enhancement, complete with planning and implementation time horizons.

Initial work consisted of gathering data and formulating assumptions required for the capacity and delay analysis and modeling. Where possible, assumptions were based on actual field observations at MIA. Proposed improvements were analyzed in relation to current and future demands with the help of FAA computer models, the Airfield and Airspace Simulation Model (SIMMOD), and the Runway Delay Simulation Model (RDSIM). Appendix B briefly explains the models.

The simulation models considered air traffic control procedures, airfield improvements, and traffic demands. Airfield configurations were prepared from present and proposed airport layout plans. Various configurations were evaluated to assess the benefit of projected improvements. Air traffic control procedures and system improvements determined the aircraft separations to be used for the simulations under both visual flight rules (VFR) and instrument flight rules (IFR) operations.

Aircraft fleet mix and schedule assumptions were derived from *Official Airline Guide* data, historical data, and Design Team and other forecasts. Aircraft volume, mix, and peaking characteristics were considered for each of the three different demand forecast levels (Baseline, Future 1, and Future 2). From this, annual delay estimates were determined based on implementing various improvements. These estimates took into account historic variations in runway configuration, weather, and demand. The annual delay estimate for each improvement was then compared to the annual delay estimate for the "Do Nothing" (existing airfield) configuration, or Improvement 1a (new air carrier runway) configuration, to identify delay reductions resulting from the improvements. Following the evaluation, the Design Team developed a plan of recommended alternatives for consideration.

Section 2

Capacity Enhancement Alternatives

Background

The capacity enhancement alternatives are categorized and discussed under the following headings:

- Airfield Improvements.
- Facilities and Equipment Improvements.
- Operational Improvements.
- User or Policy Improvements.

Figure 1 shows the current layout of the airport, plus the airfield improvements considered by the Design Team.

Figure 2 lists the capacity enhancement alternatives evaluated by the Design Team and presents the estimated annual delay savings benefits for selected improvements. The annual savings are given for the Baseline, Future 1, and Future 2 activity levels which correspond to annual aircraft operations of 580,000, 680,000, and 780,000 respectively. Please note that the delay savings benefits listed for the improvements are not necessarily additive.

Figure 3 presents the estimated cost, recommended action and suggested time frame for each capacity enhancement alternative considered by the Design Team.

Airfield Improvements

1. New Non-Precision Runway 8/26 800' North of Runway 9L/27R:

For simulation purposes, this improvement includes a midfield hold pad (under construction), a proposed new A-D Terminal, a proposed Concourse E extension, and a proposed new J concourse for both Improvements 1a and 1b. The simulation also included intersection departures for commuter/small aircraft (Improvement 15).

a. Air Carrier 8,600' Runway.

An 8,600 ft. long non-precision runway is proposed by the MIA Master Plan Update. It is currently envisioned that this runway would be used primarily for arrivals, but with occasional departures by tenants/activities along the north side of the airport and by commuter aircraft. This runway would allow exiting Runway 9L/27R to be used as a dedicated departure runway, thus increasing capacity. For simulation purposes, this alternative would also include relocation of Taxiway L midway between the existing Runway and the new Runway, a new parallel Taxiway K north and along the length of the new Runway, and associated exit taxiways and cross-over taxiways to the terminal area.

The estimated 1996 project cost is $180 million (construction cost).

Annual delay savings would be 17,420 hours or $36.95 million at the Baseline activity level; 94,920 hours or $201.32 million at Future 1; and 397,840 hours or $843.83 million at Future 2.

b. 6,000' Commuter Runway.

An option considered in the MIA Master Plan Update is the construction of a 6,000' commuter runway. Presently, approximately 30 percent of MIA's traffic is composed of commuter and other "small" aircraft (Class 5, 6, and some Class 4). Separating these aircraft from the arrival streams to the existing runways would not only reduce airborne delay for commuter aircraft, but for the air carrier aircraft operating on the other three runways as well. This improvement would include the taxiway improvements described in 1a above.

The estimated 1996 project cost is $125 million (construction cost).

Annual delay savings would be 13,720 hours or $29.11 million at the Baseline activity level; 87,110 hours or $184.77 million at Future 1; and 361,310 hours or $766.35 million at Future 2.

The Design Team does not recommend this alternative. Since much of the cost of the proposed new runway is fixed, regardless of its length, the Team believes that a better return for the investment would result from constructing the air carrier runway.

2. Install Touchdown Zone Lights on Runways 9R, 27L, 27R, and 30.

The Airport presently has Touchdown Zone Lights installed on Runway 9L. This improvement would add touchdown zone lights on Runways 9R, 27L, 27R, and 30, thus lowering the visibility minimums on each runway. This project is included in the Dade County Aviation Department's development program.

The estimated 1996 project cost is $2.2 million.

The delay savings benefits of this improvement were not estimated.

Facilities and Equipment Improvements

3. CAT II/III ILS on Runway 9R.

This improvement would establish CAT II/III instrument approach capability on Runway 9R. The imaginary surfaces used to set CAT II/III minima have been and/or can be kept clear of obstructions on this runway end. The Dade County Aviation Department has been protecting the potential for low-visibility arrivals on Runway 9R and is working with FAA to resolve navigational aid sighting issues. The 1989 Capacity Enhancement Plan recommended CAT II/III capability at the airport either on Runway 9L or 9R. Under FAA low-visibility criteria, it appears that Runway 9R is preferable, allowing Runway 9L to be used for independent departures in low visibility conditions. This improvement was congressionally mandated and is included in the Dade County Aviation Department's development program.

The estimated 1996 project cost is $3 million.

The delay savings benefits of this improvement were not estimated.

4. Install Glide Slope (End-Fire), MALSR and Middle Marker on Runway 30.

This improvement would establish precision instrument approach capability on Runway 30. Runway 30 is a main landing runway during westflow operations at the airport and is currently the only MIA runway end without a precision instrument approach. Because of obstructions which cannot be removed, the installation of glide slope and approach lights would not likely lower instrument approach minimums on Runway 30, but it would provide electronic vertical course guidance. As a result, potential benefits include enhanced safety of approaches over the city as well as noise reduction.

The estimated 1996 project cost is $1.5 million.

The delay savings benefits of this improvement were not estimated.

5. Install MALSR on Runway 12.

This improvement would lower instrument approach minimums on Runway 12 and enhance safety.

The estimated 1996 project cost is $2 million.

The delay savings benefits of this improvement were not estimated.

6. Integrated Terminal Weather System (ITWS).

The ITWS is a fully automated 21st century weather prediction system that will give air traffic personnel and pilots enhanced information on weather hazards in the airspace within about 60 miles of an airport. ITWS can both detect and predict local weather conditions impacting the airport while providing simultaneous access to controllers and pilots.

ITWS will have the capability to generate predictions of weather phenomena such as microbursts, gust fronts, storm cell movements and runway winds up to 10 minutes in advance. Additionally, the system will display weather-related data in tower cabs, terminal radar approach control facilities (TRACONs) and their associated air route traffic control centers to facilitate coordination among air traffic control personnel. This is critically important in the takeoff and landing phases of flight when weather can be especially hazardous. As a result, this system is a step toward avoiding delays caused by threatening weather and will increase the margin of safety.

ITWS will automatically integrate data from FAA and National Weather Service sensors and radars (e.g., terminal Doppler weather radar, low-level; windshear alert system, next-generation weather radar, ASR-9) and present the information to air traffic personnel via easily understood graphics and text. This will enable controllers to focus more time on normal air traffic functions since they will not need to manually interpret the data.

The estimated 1996 project cost is unknown.

The delay savings benefits of this improvement were not estimated.

7. Surface Movement Advisor (SMA).

The SMA is a new electronic data communications system designed to share an unprecedented level of information between the FAA and aviation users. SMA will exchange electronic real-time aircraft movement data messages and share that information with SMA customers such as the ATCTs, the ARTCCs, the National Central Flow Control Facility and airport users.

The real-time display and use of SMA data will facilitate better planning and analysis by all parties to the system. Such real-time analysis will result in a more efficient balancing of the demand and utilization of the available airport surface movements areas. The level of real-time information provided by SMA will enable diverse parties (controllers and airlines) to consult the same data information set for the first time. This system should empower all parties to make dynamic real-time decisions about the entry or exit of aircraft in the ATC system since supervisors, traffic management specialists, controllers and aviation users will be able to see real-time demand before aircraft even begin moving.

The SMA system is designed to process numerous daily airport activity data messages. User schedules, schedule changes, gate changes, ready to push messages, push back time, ground gate arrival time, real-time ARTS IIIA system aircraft tracking movement events, and weather reporting will serve as fundamental sources of data. The raw SMA data will be processed, analyzed, and displayed in several common arrival and departure formats. These information displays will then be provided to remote user systems connected to the SMA network. This design will enable instantaneous communication of the current status of the ATC system in terms of arrival and departure demand and performance data for each airport runway complex. Existing and planned traffic management programs, flow restrictions and weather initiatives will also be included, processed, and displayed on a real-time basis through the SMA system at a future date.

The use of the SMA system should result in more timely dynamic decisions which have the potential to save the aviation system millions of dollars.

The estimated 1996 project cost is unknown. The delay savings benefits of this improvement were not estimated.

8. Vortex Advisory System (VAS)/AVOSS:

Under current conditions, air traffic controllers cannot detect the presence of wake vortices. Therefore, to guard against these potential hazards, increased separations between aircraft are maintained. The Wake Vortex Advisory System (WVAS) would increase capacity by permitting reduced spacing between aircraft when wake vortices present no hazards to following aircraft. It is anticipated that joint FAA and National Aeronautics and Space Administration (NASA) efforts, using a radar type sensing technology named the Automated Vortex Sensing System (AVOSS), will yield an operational system by 1998.

For simulation purposes, this improvement assumed Improvement 1a in place.

The estimated 1996 project cost is unknown.

a. Simultaneous Departures from Three Parallel Runways (VFR).

Annual delay savings, in addition to Improvement 1a, would be 400 hours or $0.85 million at the Baseline activity level; 270 hours or $0.57 million at Future 1; and 2,570 hours or $5.44 million at Future 2.

b. Simultaneous Departures and Arrivals to Three Parallel Runways (VFR).

Annual delay savings, in addition to Improvement 1a, would be 2,110 hours or $4.48 million at the Baseline activity level; 3,880 hours or $8.23 million at Future 1; and 15,050 hours or $31.90 million at Future 2.

Operational Improvements

9. Dependent Non-Precision Approaches to New Runway 8/26.

The proposed new north parallel runway is planned to have localizer only non-precision approaches to both ends. The Design Team assessed the benefits of conducting 2 NM staggered approaches in conjunction with the existing Runway 9L/27R, 800 ft. to the south.

Annual delay savings, in addition to Improvement 1a, would be 120 hours or $0.26 million at the Baseline activity level; 640 hours or $1.36 million at Future 1; and 840 hours or $1.76 million at Future 2.

10. Side-Step Non-Precision Approaches to New Runway 8/26.

This improvement was simulated under a special case of IFR weather (ceiling less than 1,000 feet and/or visibility less than 3 miles) as opposed to the IFR weather (ceiling less than 2,500 feet and/or visibility less than 3 miles) used for the other improvements. Miami tower anticipated the new runway would not be used for arrivals when the ceiling was less than 1,000 feet and/or the visibility was less than 3 miles. Instead, arrivals would use Runway 9L/27R. The Design Team evaluated the benefits of conducting side-step non-precision approaches to the proposed new runway using the Runway 9L/27R Instrument Landing Systems (ILSs).

An arrival to the new north runway would make its approach to MIA using the Runway 9L/27R ILS. When it had visual contact with the airport, it would side-step to land on the north runway. As soon as the arrival made its turn to begin the side-step, a departure on Runway 9L/27R could move into position. The departure could be released as soon as the arrival touched down on the north runway and slowed to taxi speed (to assure no missed approach). If Runway 9L/27R is used for arrivals as proposed by Miami Tower, the departure could not move into position and be released until the arrival had exited the runway. Therefore, the benefit of this improvement is in being able to reduce departure delays.

The Design Team did not annualize the delay savings benefits of this improvement due to the lack of detailed weather data for IFR conditions (ceiling less than 1,000 feet and/or visibility less than 3 miles).

However, the delay savings benefits in terms of minutes of delay per operation during these weather conditions were determined to be: 2.1 minutes per operation in east flow and 4.8 minutes per operation in west flow at the Baseline activity level; 1.1 minutes per operation in east flow and 0.8 minutes per operation in west flow at the Future 1 activity level; and, 2.4 minutes per operation in east flow and 12.7 minutes per operation in west flow at the Future 2 activity level.

11. Intersection Departures for Commuter/Small Aircraft.

Alternate runway entrances are available for aircraft departing all runways except 27L. While significant use by jet aircraft will probably not be acceptable to the surrounding community, the use of intersection departures by commuter aircraft and small general aviation aircraft may be possible. Analysis of this alternative is included in the discussion of improvement 1a.

For simulation purposes, this improvement was included in Improvement 1a and 1b. Therefore, the delay savings benefits of this improvement are included in the delay savings benefits of Improvement 1a and 1b.

12. Intersection Departures for Cargo Aircraft on Runway 27L.

Most cargo aircraft at MIA utilize cargo aprons on the west side of the airport. During west airfield operations, these aircraft must cross a main landing runway (30) and enter the congested takeoff queuing area for Runway 27L along the south side of the terminal area. An intersection departure length on Runway 27L of 9,700 ft. is available from Taxiway T5. The Design Team evaluated the benefits of intersection departures for cargo aircraft from this location.

For simulation purposes, this improvement assumes Improvement 1a in place.

Annual delay savings/(costs), in addition to Improvement 1a, would be (30) hours or ($0.07 million) at the Baseline activity level; 4,410 hours or $9.36 million at Future 1; and 10,620 hours or $22.52 million at Future 2.

13. Optimize Runway Crossing /Taxi Path and Flows for New Runway, Runway 9L/27R, and Terminal Area.

The approved Airport Layout Plan (ALP), developed under the 1994 Master Plan Update, called for the reconstruction of Taxiway L between the existing Runway 9L/27R and the new proposed north runway, a distance of 400 feet from each runway centerline. With the primary use of the proposed new runway being for landings and the existing 9L/27R for departures, procedures need to be established to allow holding aircraft between the runways and crossing Runway 9L/27R to ingress into the terminal area.

For this improvement in east flow, the simulation assumed aircraft taxiing to their gates on the south side of the airfield crossed Runway 9L at Taxiway L4/W, instead of crossing Runway 9L immediately after exiting Runway 8. In the simulation of Improvement 1a, these aircraft cross Runway 9L immediately after exiting Runway 8.

For simulation purposes, this improvement assumes Improvement 1a in place.

Annual delay savings/(costs), in addition to Improvement 1a, would be 580 hours or $1.24 million at the Baseline activity level; (910) hours or ($1.93 million) at Future 1; and 1,010 hours or $2.12 million at Future 2.

14. Reduced IFR Arrival In-Trail Spacing to 2 Nautical Miles.

The minimum in-trail separation under IFR conditions for aircraft inside the outer marker is currently 2.5 NM when wake turbulence is not a factor. This improvement proposes to reduce minimum IFR in-trail separations to 2.0 NM unless wake turbulence separation requirements dictate otherwise. This would increase arrival runway capacity.

In order to reduce in-trail separations, runway occupancy times (ROTs) would need to be reduced so that departure flow is not restricted and so that an excessive number of missed approaches does not occur. This may be possible through pilot training. The Design Team recognizes that a more detailed study would be needed before this improvement could be implemented through a new national standard.

Annual delay savings would be 470 hours or $0.99 million at the Baseline activity level; 610 hours or $1.29 million at Future 1; and 400 hours or $0.85 million at Future 2.

15. Establish 3rd Departure Heading for Jet Takeoffs in Westflow Conditions:

The Design Team evaluated the benefits of modifying the existing 270 degree and 290 degree initial heading to 265, 280, and 295 degrees. It should be noted that the additional departure heading would require an environmental impact assessment. The evaluation considered day and night operations and day only operations.

a. Day and Night Operations.

Annual delay savings would be 1,450 hours or $3.08 million at the Baseline activity level; 17,570 hours or $37.26 million at Future 1; and 23,630 hours or $50.13 million at Future 2.

The Design Team does not recommend this alternative. The Team believes the additional delay savings over the Day Only alternative would not justify the nighttime noise impacts that would result from it.

b. Day Only Operations (7AM - 10PM).

Annual delay savings would be 1,540 hours or $3.27 million at the Baseline activity level; 17,020 hours or $36.09 million at Future 1; and 22,900 hours or $48.57 million at Future 2.

16. Operational Impact of New Large Aircraft.

It is possible that MIA will receive some activity by new aircraft with dimensions considerably exceeding those of current B-747-400 aircraft. Manufacturers and airlines are discussing aircraft with lengths of 260-280 feet and wingspans of approximately 260 feet. The airport is anticipating that 10-12 departures per day, (3-4 per peak hour), by these new large aircraft could occur at MIA within the next 10-15 years. The existing taxiway system at MIA is sized to accommodate Aircraft Design Group V. Under specific aircraft design criteria, the existing taxiway separations and clearances can accommodate aircraft with a wingspan of up to 229 feet. The Dade County Aviation Department has proposed limiting operations by these new large aircraft with wingspans approaching 260 feet to the parallel taxiways farthest from the runways (N, P, and S). This would be accomplished either by obtaining a modification of design standards waiver from the FAA or by relocating/reconstructing these taxiways at a centerline separation of 278 feet from the dual taxiway closest to the runway. In the first option, simultaneous taxiway operations would be limited to Aircraft Design Group V (B-747) on the taxiway closest to the runway with the new large aircraft on the farthest taxiway. In the second option, simultaneous taxiway operation would be limited to Aircraft Design Group IV (MD-11) on the taxiway closest to the runway with new large aircraft on the farthest taxiway.

The delay savings benefits of this improvement were not estimated.

17. Standard Taxi Routes.

This improvement involves standardizing taxi routes on the airport. The primary benefit would be reduced communication required between pilots and controllers.

The delay savings benefits of this improvement were not estimated.

18. Use of Taxiway U for Runway 26 Commuter Departures in Westflow Conditions.

Currently, when Runway 27R is being used for arrivals, Taxiway U is not usable. However, in the future when Runway 26 is being used for arrivals and Runway 27R is being used for departures, this restriction would no longer apply. This alternative examines the benefits of routing Runway 26 commuter aircraft departures around Runway 27R in west flow. This would prevent the commuter departures from having to cross an active runway. It also would prevent commuter departures from having to wait in the departure queue of Runway 27R.

For simulation purposes, this improvement assumes Improvement 1a is in place.

Annual delay savings/(costs), in addition to Improvement 1a, would be 280 hours or $0.59 million at the Baseline activity level; 4,710 hours or $10.0 million at Future 1; and (2,660 hours) or ($5.66 million) at Future 2.

User or Policy Improvements

19. Uniformly Distribute Scheduled Commercial Operations.

A more uniform distribution of airline flights during peak periods would promote a more orderly flow of traffic, reduce arrival and departure delays, and reduce ground congestion near the terminal and on the taxiway system.

Annual delay savings would be 6,870 hours or $14.57 million at the Baseline activity level; 5,690 hours or $12.06 million at Future 1; and 19,850 hours or $42.09 million at Future 2.

However, MIA is part of a hub-and-spoke operation and uniform distribution of traffic is not consistent with such an operation. Hubbing creates efficiencies that cannot be measured by the computer simulation models used for this study. The hub-and-spoke system of operations provides frequent service between city-pairs that could not support frequent direct service. Frequent flights provide an economic benefit to consumers, particularly business flyers. Therefore, the Design Team does not recommend this improvement.

20. Effect of Noise Abatement Restrictions.

Dade County and the MIA ATCT have implemented, or are considering implementation of, certain noise abatement measures at MIA, mainly during the night time hours. The Design Team evaluated the impact of these measures.

For simulation purposes, this improvement assumes Improvement 1a in place.

Annual delay costs would be (1,520 hours) or ($3.21 million) at the Baseline activity level; (2,990 hours) or ($6.34 million) at Future 1; and (7,130 hours) or ($15.14 million) at Future 2.

21. Enhancement of the Reliever and GA Airport System.

Reliever and GA airports can ease capacity constraints by attracting small/slow aircraft away from primary airports, especially where small/slow aircraft constitute a significant portion of operations. The segregation of aircraft operations by size and speed increases effective capacity because required time and distance separations are reduced between planes of similar size and speed.

The Design Team examined the benefits of reducing GA activity at MIA by reducing the numbers of Class 4, 5, and 6 aircraft in the fleet mix. However, Dade County currently has restrictions on commercial operations at its reliever and GA airports. Therefore, because they are commercial operators, some of the small/slow aircraft at MIA would not be able to relocate to these airports as assumed in the simulations. The Design Team believes the results obtained from the simulations could not easily be implemented, and therefore, decided not to publish them in this report.

Section 3

Summary of Technical Studies

Overview

The Miami International Airport Design Team evaluated the efficiency of the existing airfield and the proposed future configurations. A brief description of the computer models and methodology used can be found in Appendix B. Certain standard inputs were used to reflect the operating environment at MIA. Details can be found in the summary data packages produced by the Federal Aviation Administration Technical Center. The potential benefits of various improvements were determined by examining airfield capacity, airfield demand, aircraft delays and travel times.

The Design Team used the Airport and Airspace Simulation Model (SIMMOD) and the Runway Delay Simulation Model (RDSIM) to determine aircraft delays and travel times during peak periods based on weather conditions, traffic distribution, runway use, and other variables. Daily operations corresponding to an average day in the peak month were used for each of the forecast periods. Figures 4 and 5 illustrate the average-day, peak-month demand levels for MIA for each of the three annual activity levels used in the study, Baseline, Future 1, and Future 2. Figure 6 shows current airfield weather conditions and percentage of occurrence. Figure 7 defines aircraft classes operating at MIA. Figure 8 breaks down the daily traffic distribution by aircraft class for each demand level. Figure 9 shows the aircraft approach speeds used for simulation. Figure 10 depicts the length of common approach, while Figure 11 reflects departure runway occupancy times (ROT) in seconds. Figure 12 depicts current and future runway use in east and west flows.

Delays were calculated for current and future conditions. Daily delays were annualized using a value of 350 equivalent days for all three demand levels. The annualized delays provided a basis for determining the benefits of the proposed improvements. The annualized delay of each improvement was subtracted from the annualized delay for either the "Do Nothing" case, or Improvement 1a as appropriate, to determine its benefit in terms of delay savings.

The aircraft fleet mix at MIA has a weighted-average direct operating cost of $2,121 per hour, or $35 per minute. These figures are based on the Miami daily traffic sample, type of aircraft distribution and operating cost data for scheduled and non-scheduled operations. They represent the costs for operating the aircraft and include such items as fuel, maintenance, and crew costs, but they do not consider lost passenger time, disruption to airline schedules, or other non-traditional factors.

The annualized delay savings of each improvement was multiplied by the weighted-average aircraft direct operating cost to determine its delay cost savings. The implementation cost of a particular improvement was compared to its annual delay cost savings. This comparison indicated which improvements would be of most value and, therefore, recommended by the Design Team.

Figure 4. Profile of Daily Demand

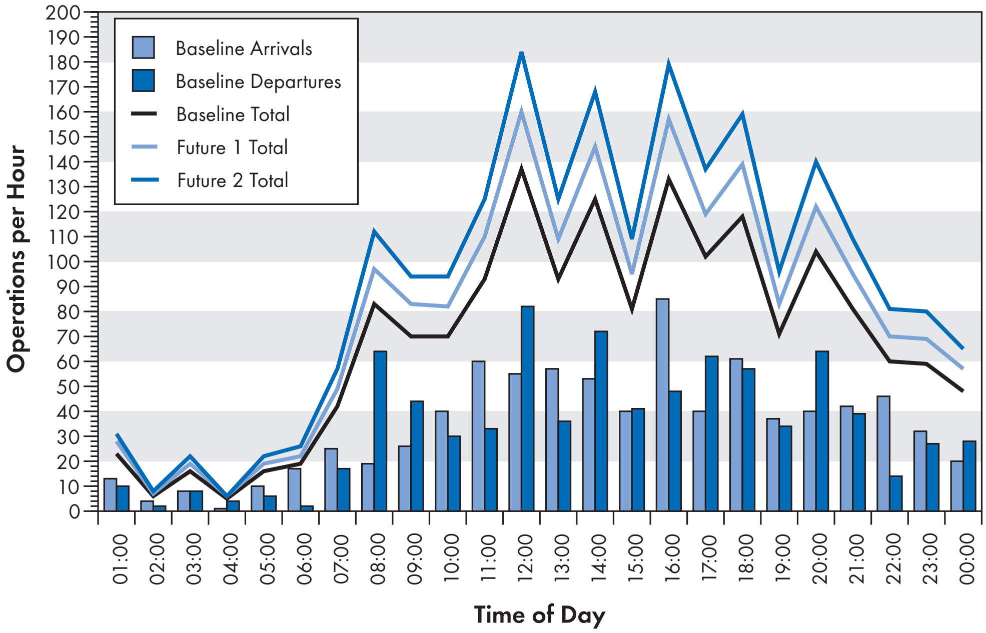


Figure 5. Airfield Demand Levels

	Annual Operations	24-Hour Day (Average Day, Peak Month)	Equivalent Days
Baseline	580,000	1,655	350
Future 1	680,000	1,943	350
Future 2	780,000	2,229	350

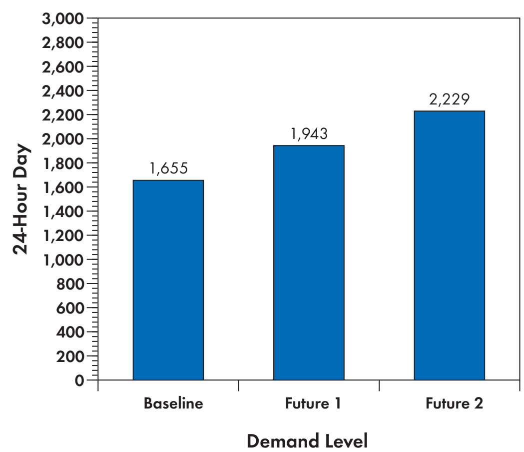


Figure 6. Airfield Weather

Operations	Ceiling/Visibility	Occurrence
VFR	≥2,500 ft./≥3 miles	98.6%
IFR 1	<2,500 ft./<3 miles/	1.4%

Figure 7. Aircraft Class Definitions

Original Aircraft Class	New Aircraft Class	Type of Aircraft[a]
D(1)	1	Heavy Aircraft[c] weighing more than 255,000 lbs[b] (e.g., A300, B707-300,400 Series, B747, B767, DC8S, IL62, L1011)
C(2)	2	Large (B757) - Special class aircraft
C(2)	3	Large aircraft weighing more than 100,000 lbs[b] and up to 255,000 lbs[b] (e.g., B737, B727, DC9, EA32, MD88)
C(2)	4	Large aircraft weighing more than 41,000 lbs[b] and up to 100,000 lbs[b] (AT72, DH7, G2, FK10, SF34)
B(2)	5	Small aircraft weighing more than 12,500 lbs[b] and up to 41,000 lbsb (e.g., BE02, BE99, DH8, LR35, SH360, DC3, SW3)
B(3)	6	Small, twin-engine aircraft (props) weighing 12,500 lbs[b] or less (e.g., BE55, BE58, C12, C26A, C414, C421, D08, P180, PA31, PAZ, U21)
A(4)	6	Small, single-engine aircraft (props) weighing 12,500 lbs[b] or less (e.g., C208, C210, 172RG)

Notes:

a. For aircraft designator, see FAA Handbook 7340.1E with changes.
b. Weights refer to maximum certified takeoff weights.
c. Heavy aircraft are capable of takeoff weights of 255,000 pounds or more, whether or not they are operating at this weight during a particular phase of flight (reference FAA Handbook 7110.65 with changes).

Figure 8. Daily Traffic Distribution by Aircraft Class (Percentage)

Class	1	2	3	4	5	6
Baseline	16	8	33	22	11	9
Future 1	16	8	33	22	11	9
Future 2	16	8	33	22	11	9

Figure 9. Aircraft Approach Speeds (Knots)

Class	1	2	3	4	5	6
Standard	140	130	130	130	130	120
Miami*	150	145	150	148	142	134

* Averaged from 6 days of ARTS Data with 6 NM common approach.

Figure 10. Length of Common Approach (Nautical Miles)

Class	1	2	3	4	5	6
VFR	6	6	6	6	6	6
IFR	6	6	6	6	6	6

Figure 11. Departure Runway Occupancy Times (Seconds)

Class	1	2	3	4	5	6
Seconds	38	31	39	27	25	27

Airfield Capacity

The MIA Design Team defined airfield capacity to be the maximum number of aircraft operations (landings or takeoffs) that can take place in a given time under given conditions. Airfield capacity is a complex issue that cannot be represented by a single value, but changes as conditions change. The following conditions were considered:

- Level of delay.
- Airspace constraints.
- Ceiling and visibility conditions.
- Runway layout and use.
- Aircraft mix.
- Percent arrival demand.

The curves in Figures 13 and 14 depict the relationship between airfield capacity, stated in the number of operations per hour and the average delay per aircraft for both the current and future airfields in both east and west flow.

Figure 13 shows that in east and west flow VFR conditions, the current airfield can accommodate from 94 to 125 aircraft per hour, depending on direction of flow and arrival/departure ratio, before delays begin to rapidly escalate. Figure 4 (Profile of Daily Demand) shows that while hourly demand exceeds these levels at certain hours of the day at the Baseline level, hourly demand exceeds these levels for several consecutive hours of the day at the Future 1 and 2 demand levels.

Figure 14 shows that in east and west flow VFR conditions, the future airfield (with new air carrier runway) can accommodate from 116 to 147 aircraft per hour, depending on direction of flow and arrival/departure ratio, before delays begin to rapidly escalate. Figure 4 shows that, while this is an increase in capacity over the current airfield, hourly demand will still exceed hourly capacity at certain hours of the day at the Baseline demand level and, hourly demand will still exceed hourly capacity frequently at the Future 1 and 2 demand levels.

Figure 12. Runway Use — Current and Future

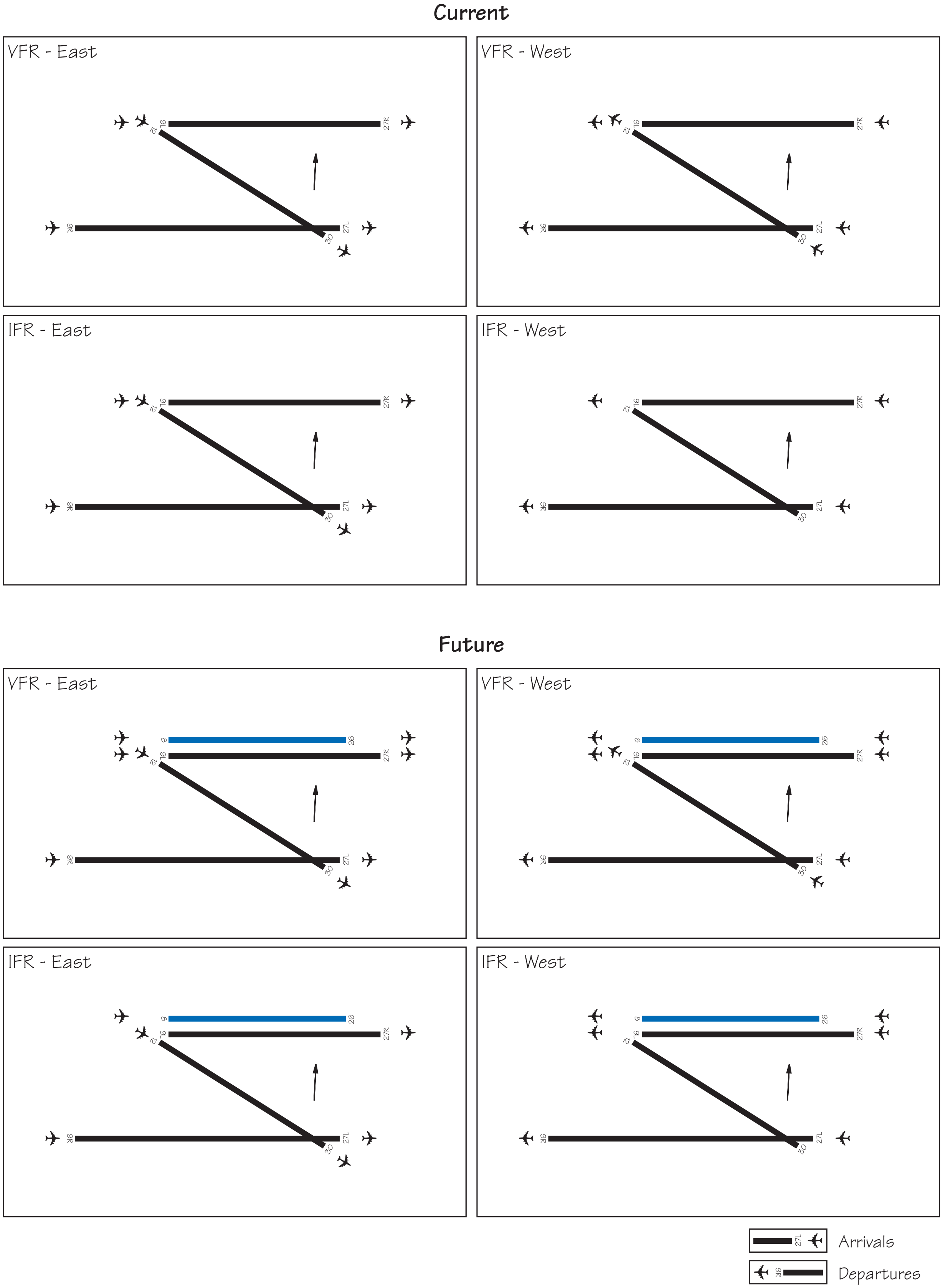


Figure 13. Airport Capacity Curves — Hourly Flow Rate Versus Average Delay, Current Airfield (VFR)

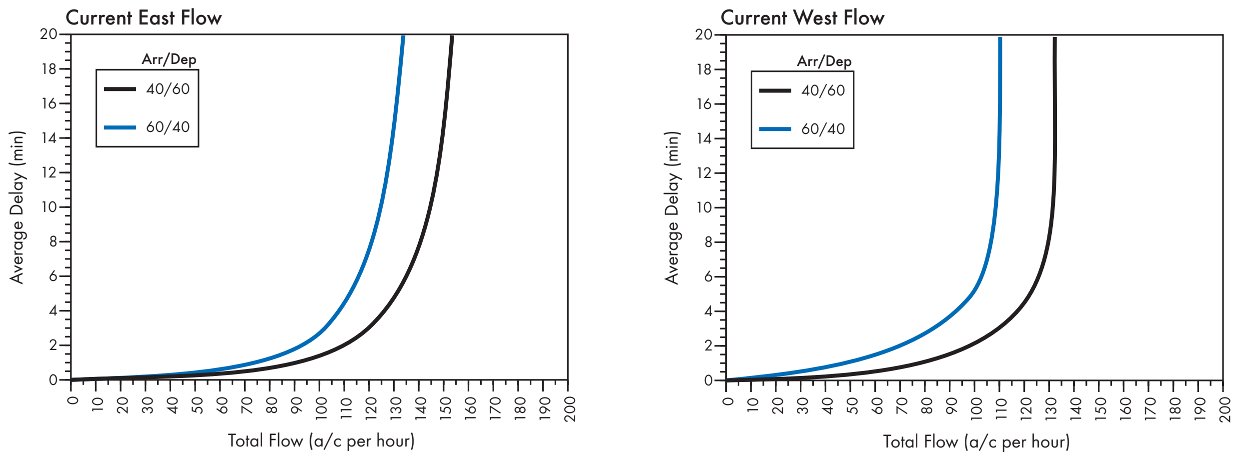
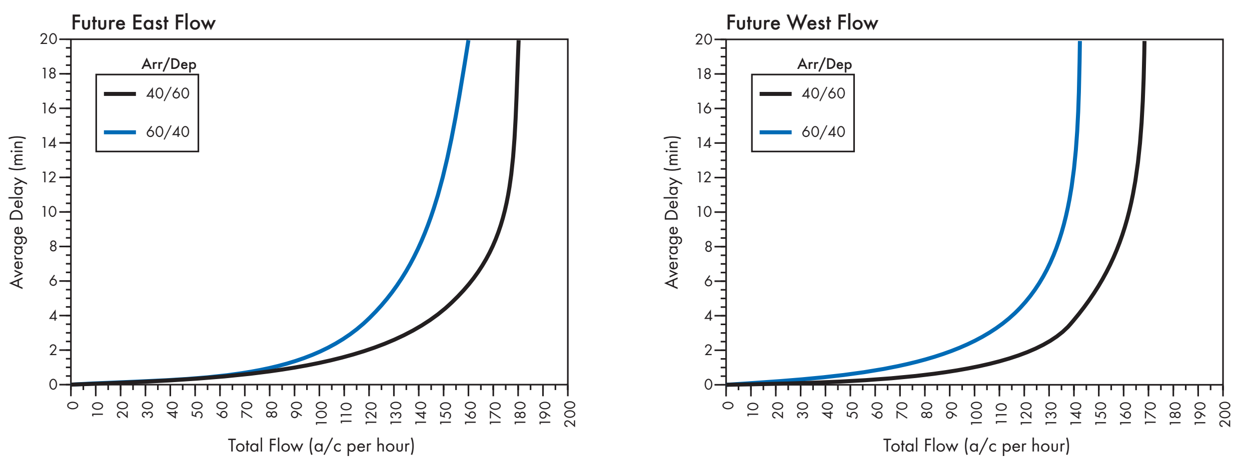


Figure 14. Airport Capacity Curves — Hourly Flow Rate Versus Average Delay, Future Airfield (VFR)



Aircraft Delays

Aircraft delay is defined as the time above the unimpeded travel time for an aircraft to move from its origin to its destination. Aircraft delay results from interference from other aircraft competing for the use of the same facilities.

The major factors influencing aircraft delays are:

- Ceiling and visibility conditions.
- Airfield and ATC system demand.
- Airfield physical characteristics.
- Air traffic control procedures.
- Aircraft operational characteristics.
- Fleet Mix.

Total daily delays in minutes were generated by either the Airport and Airspace Simulation Model (SIMMOD) or the Runway Delay Simulation Model (RDSIM) depending on which model was appropriate for the particular simulation. Descriptions of these models are included in Appendix B. The daily delays were converted from minutes to hours and annualized. If no improvements are made in airport capacity, the annual delay of 41,677 hours (4.31 minutes per operation) at the Baseline level of operations will increase to 151,598 hours (13.38 minutes per operation) by Future 1 and 542,174 hours (41.71 minutes per operation) by Future 2. Under this "Do Nothing" scenario (no improvements in airfield capacity, assuming no gate capacity constraints), the annual delay costs are predicted to increase as shown here:

	Hours	Minutes Per Operation	Millions of 1996 Dollars
Baseline	41,677	4.31	88.40
Future 1	151,598	13.38	321.54
Future 2	542,174	41.71	1,149.95

The Design Team recognizes that the Future 2 level of delay estimated by the unconstrained computer simulation would not actually occur. This level of delay would be unacceptable to the airlines and their passengers. At some level of delay prior to this, the capacity of MIA would be reached and further growth in traffic would be constrained. However, it does point out that if no improvements are made at MIA, at some point beyond Future 1, delays and delay costs will become unacceptable.

Conclusions

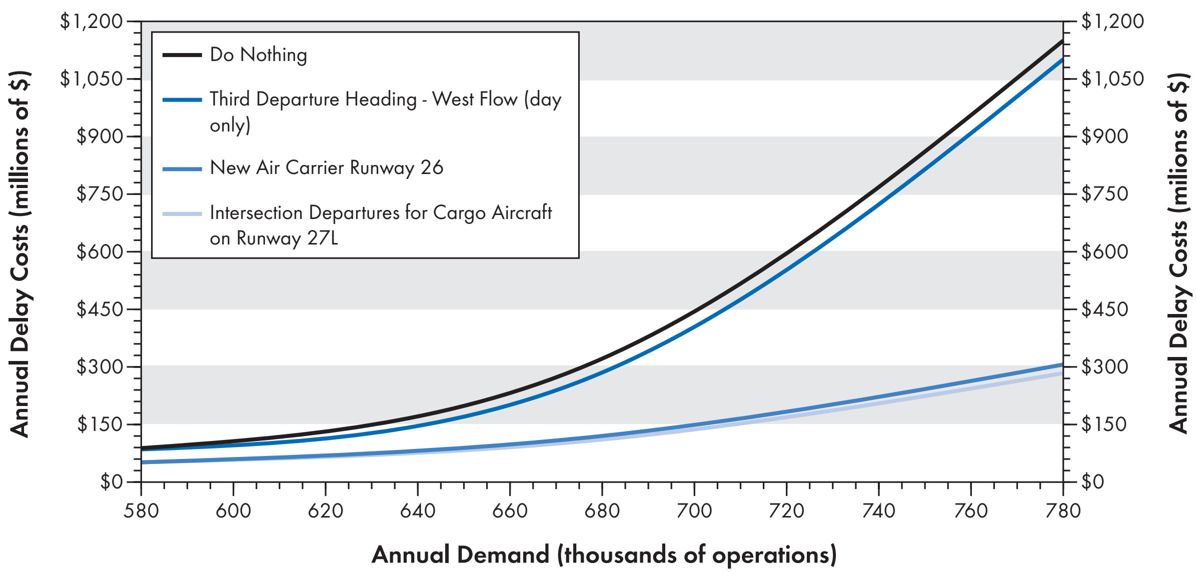
Figure 15 demonstrates the impact of delays at Miami International Airport. The charts show how annual delay costs and average delays will continue to grow at a substantial rate as demand increases if there are no improvements made in airfield capacity, i.e., the "Do Nothing" scenario. The graphs also show that the greatest savings in average delays and annual delay costs would be provided by:

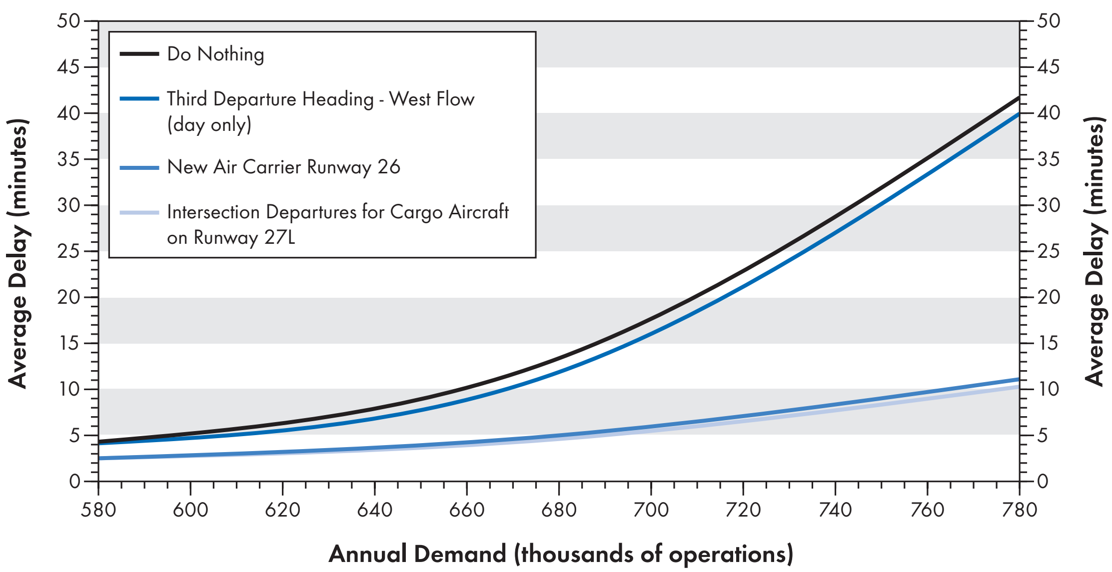
- New non-precision air carrier Runway 8/26.
- Establishing a 3rd departure heading for jet takeoffs - west flow (day only operations).
- Intersection departures for cargo aircraft on Runway 27L.

The Design Team recommends implementing these, and other improvements, at the appropriate time as indicated in Figure 3. However, note that the delay savings benefits of these alternatives are not necessarily additive.

As stated previously, the Design Team recognizes that the Future 2 level of delay estimated by the unconstrained computer simulation would not actually occur. This level of delay would be unacceptable to the airlines and their passengers. At some level of delay prior to this, the capacity of MIA would be reached and further growth in traffic would be constrained. However, it does point out that if no improvements are made at MIA, at some point beyond Future 1, delays and delay costs will become unacceptable.

Figure 15. Delay Costs and Average Delays — Capacity Enhancement Alternatives





Appendix A

Participants

Federal Aviation Administration

Southern Region - Airports Division
Troy Butler
Bart Vernace

Headquarters
Donald J. Guffey

Technical Center
John Vander Veer
Doug Frye
Jennifer Morris

Miami Air Traffic Control Tower
Joe Petrucci
Jeff Baker
Bonnie Schultz
Christy Larson
Bob Price
Jeff Rutledge

Miami Air Route Traffic Control Center
Sid Cooper
Gary Fournier
Mark Palazzo
Scott Turner

Dade County Aviation Department
Manuel Rodriguez
Sunil Harman
Bill Carreras
Rick Busch

Florida Department of Transportation
David Bjorneboe
Richard Duley

Aviation Industry Groups

American Airlines
Wes Friedman
Sam Smith
M.R. Hugonnett

***United Airlines**
*D. Garcia
*Jay Dayhoff
*Gary Lantner

Dade Aviation Consultants
Juan Nunez
Miriam Gerov
Larry Coleman

Air Transport Association
Paul McGraw

SABRE Decision Technologies
Cheryl Daniels

HNTB
K.I. Schwinger

Ricondo & Associates
Ramon Ricondo
Matt Davis

* Non-Participating Report Recipients

Appendix B

Computer Models and Methodology

The Miami Design Team studied the effects of various improvements proposed to reduce delay and enhance capacity. The options were evaluated considering the anticipated increase in demand. The analysis was performed using computer modeling techniques. A brief description of the models and the methodology employed follows.

Computer Models

Airport and Airspace Simulation Model (SIMMOD)

SIMMOD is a fast-time, event-step model that simulates the real-world process by which aircraft fly through air traffic controlled en route and terminal airspace and arrive and depart at airports. SIMMOD traces the movement of individual aircraft as they travel through the gate, taxiway, runway, and airspace system and detects potential violations of separations and operation procedures. It simulates the air traffic control actions required to resolve potential conflicts to insure that aircraft operate within procedural rules. Aircraft travel time, delay, and traffic statistics are computed and provided as model outputs. The model was calibrated for this study against field data collected at MIA to ensure it was site specific. Inputs for the simulation model were also derived from empirical field data. The model repeated each experiment 10 times using Monte Carlo sampling techniques to introduce system variability. The results were then averaged to produce output statistics.

Runway Delay Simulation Model (RDSIM)

The Runway Delay Simulation Model (RDSIM) is a short version of the Airfield Delay Simulation Model (ADSIM). RDSIM simulates only the runways and runway exits and adjacent airspace. There are two versions of the model. The first version ignores the taxiway and gate complexes for a user-specified daily traffic demand and is used to calculate daily demand statistics. In this mode, the model replicates each experiment forty times, using Monte Carlo sampling techniques to introduce system variability, which occurs on a daily basis in actual airport operations. The results are averaged to produce output statistics. The second version also simulates the runway and runway exits only, but it creates its own demand using randomly assigned arrival and departure times. The demand created is based upon user-specified parameters. This form of the model is suitable for capacity analysis.

For this study, RDSIM was calibrated against field data collected at MIA to ensure that the model was site specific. For a given demand, the model calculated the hourly flow rate and average delay per aircraft during the full period of airport operations. Using the same aircraft mix, simulation analysts simulated different demand levels for each run to generate demand versus delay relationships.

Methodology

Model simulations included present and future air traffic control procedures, various airfield improvements, and traffic demands for different times. To assess the benefits of proposed airfield improvements, different airfield configurations were derived from present and projected airport layouts. The projected implementation time for air traffic control procedures and system improvements determined the aircraft separations used for IFR and VFR weather simulations.

For the delay analysis, agency specialists developed traffic demands based on the *Official Airline Guide*, historical data, and various forecasts. Aircraft volume, mix and peaking characteristics were developed for three demand periods, Baseline, Future 1 and Future 2. The estimated annual delays for the proposed improvement options were calculated from the experimental results. These estimates took into account the yearly variations in runway configurations, weather, and demand based on historical data.

The potential delay reductions for each improvement were assessed by comparing its annual delay estimates with the annual delay estimates for either the “Do Nothing” case or Improvement 1a, whichever was appropriate for the particular improvement.

Appendix C

List of Abbreviations

ADSIM	Airfield Delay Simulation Model
ARTCC	Air Route Traffic Control Center
ASC	Office of System Capacity and Requirements, FAA
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
AVOSS	Automated Vortex Sensing System
CAT	Category — of instrument landing system
MIA	Miami International Airport
FAA	Federal Aviation Administration
GA	General Aviation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
ITWS	Integrated Terminal Weather System
LBS	Pounds
NM	Nautical Miles
RDSIM	Runway Delay Simulation Model
ROT	Runway Occupancy Time
RVR	Runway Visual Range
SIMMOD	Airport and Airspace Simulation Model
SM	Statute Miles
SMA	Surface Movement Advisor
SMGCS	Surface Movement Guidance and Control System
TRACON	Terminal Radar Approach Control
VAS	Vortex Advisory System
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
WVAS	Wake Vortex Advisory System

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